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High-T_c SNS Weak Links Using Oxide Normal Metals

B.D. Hunt, J. B. Barrier, M. C. Foote, and R.P. Vasquez

Center for Space Microelectronics Technology
JCt,l'repulsion Laboratory, California Institute of Technology
Pasadena, California 91109

Fabrication of high-quality, epitaxial SNS weak links with $YBa_2Cu_3O_{7-x}$ (YBCO) electrodes requires normal metals which are lattice-matched, chemically compatible, and possibly thermal-expansion-matched to YBCO. These requirements point to the use of oxide normal metals with compositions and structures similar to YBCO. This work examines device results for edge-geometry SNS weak links utilizing a variety of oxide normal metals, including a nonsuperconducting form of YBCO (N-YBCO), $PrBa_2Cu_3O_{7-x}$ (PBCO), and 1 .a and Co-doped YBCO. The devices are produced using an *in-situ* ion milling process to produce a tapered YBCO base-electrode edge with a MgO or $SrTiO_3$ milling mask. High-quality, RSJ-like electrical characteristics have been obtained with all of these barrier materials, and the devices generally show the expected exponential dependence of J_c on barrier thickness, with the exception of the La-doped-YBCO normal-metal devices. A comparison of the electrical properties of these devices, including I_cR_n, J_c, and the magnetic field response will be presented. Device reproducibility will also be discussed.

This talk will also examine recent progress in fabrication of epitaxial SNS weak links on silicon-on-sapphire (SOS) substrates. SOS substrates have acceptably low dielectric constants for many high-frequency applications, and offer the possibility of monolithic integration of silicon and superconducting circuitry. We have fabricated YBCO edge-geometry weak links with PBCO normal metal layers on r-plane SOS substrates using cubic zirconia (YSZ) buffer layers. These devices show good-quality RSJ-like I-V characteristics, but the electrical characteristics also indicate the presence of a second weak link in series with the edge-defined weak link, probably due to the nucleation of a grain boundary in the counterelectrode at the YSZ/base-YBCO interface. Recently, wc have developed a new buffer layer combination which allows the growth of high quality YBCO/$SrTiO_3$ bilayers above the YSZ film. SNS weak links fabricated using this approach are under investigation, and preliminary results on these devices will be reported.